UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BERKELEY, CALIFORNIA

CIRCULAR 286
MAY, 1925

MILK HOUSES FOR CALIFORNIA DAIRIES

BY H. L. BELTON AND J. D. LONG*

WELL LOCATED MILK HOUSE

A 25 ft. by 25 ft. tile block house with stucco exterior. Straining room connected with milking barn. Used for a herd of 80 cows.

This circular on milk house construction is prepared with the thought of showing how the dairyman may construct such a building at a reasonable expenditure of capital with the assurance that the probable life of the building will be as great as is consistent with the type of construction and the materials indicated. All plans show concrete

* The authors wish to acknowledge the services rendered in the preparation of this circular by Dr. C. L. Roadhouse and Professor G. D. Turnbow of the Division of Dairy Industry, and Dr. J. J. Frey of the State Department of Agriculture.

floor and splash base, with wood framing and roof, as such construction at the present time requires the smallest initial expenditure consistent with good construction practice. Concrete, tile, or stone, however, may well be used in place of the wood with the assurance that good construction of this type will give greater satisfaction in the matters of sanitation, temperature regulation, cost of upkeep and length of life. Such construction also lowers the fire hazard.

Certain items of built-in equipment are included in this publication as worthy of consideration at the time of erecting the house. The prospective builder should make certain to plan a house large enough to care for possible growth in the immediate future and to include such built-in equipment as may be needed in a size sufficient to care for the milk then produced.

Dairying in California has an assured future. Equipment for engaging in such a stable industry should be such as will enable the dairyman to produce the product of the highest quality practicable. Well-built, sanitary and labor saving buildings and equipment not only save money in depreciation and labor, but make the work more attractive. Such a dairy layout not only is a source of pride to the owner but promises a definite financial return from the favorable rating of the dairy inspector.

REQUIREMENTS OF THE STATE DAIRY LAW

The legal definition of a dairy according to 'Special Publication No. 26''—''Important Provisions of the California Dairy Laws,'' published by the State Department of Agriculture, is as follows: ''Two or more cows in full lactation, or freshening within four months of each other, and producing milk or cream sold to the public, constitute a commercial dairy.''

The same publication summarizes the provisions of the state dairy law as follows: ''These provisions of the law may almost be summarized in the two words 'Be Clean.' It provides (*a*) that the drinking water be clean; (*b*) that the yards be clean; (*f*) that the walls be clean; (*g*) that the barns be clean; (*h*) *that the milk containers be clean;* (*i*) that the milkman himself be clean. It requires further that a Milk House, separate from the barns and dwelling houses, properly screened and used for no other purpose, shall be provided. Premises liable to become dirty, like pigpens or chicken houses, must be at least 100 feet away from the milk house, but the milk house may be very close to the cow barn if the barn is kept clean. A man

is not required by the state law to have a barn, but if he does have one, he must keep it clean and he must not keep his milk in it. Also he should keep the manure at least 50 feet away from the barn and outside of corrals. If milking is done in the corral, then the corral must be kept clean and the accumulation of manure must be kept at least 50 feet away."

Certain city boards of health are more specific as to the actual construction of the milk house—as to how high concrete shall extend up the side wall, how the interior of the milk room shall be finished, and what rooms and equipment shall be provided. It has not seemed practicable to attempt to fulfill all these requirements in any one plan in this circular. In case a plan such as any appearing in this circular is decided upon for construction, it would be advisable to consult with the inspector or city health officer before construction is started, to make certain that the plan will meet the requirements for the district and for the grade of product to be sold.

LOCATION

As already stated, the milk house may be close to the milking barn but must be at a minimum distance of 100 feet from nuisances, such as stagnant water and accumulations of manure or other filth. An enclosed passage way or corridor may connect the milking barn and milk house under certain conditions. These conditions according to the regulations of one city are: "The milk room may be under the same roof as the milking barn, but must be apart therefrom, separated by a clean ventilated room or passageway at least four feet long and four feet wide, with door kept closed by springs." The state dairy law specifically states that the milk house must not be constructed as a part of any other building, except as it may be connected to the milking barn. The milk house should be placed, if possible, on the windward side of the barn where dust or odors will not readily reach it and where prevailing winds will tend to keep the doors free from flies.

Other factors to be considered in the location are drainage and ease of loading. The site should be well drained, higher than its surroundings if possible, and with drainage from milk house to milking barn, rather than vice versa. Placing the milk house close to the driveway where cans may be readily loaded or discharged will facilitate handling.

SIZE AND ARRANGEMENT

The best size for the milk house depends upon several factors, chiefly, however, the size of the herd; that is, the amount of produce to be handled, the methods of caring for the milk, the machines and equipment required, and the manner of marketing—as cream, bulk or bottled milk. Perhaps the best general directions that can be given as to size are to provide sufficient space for the cooling vat or refrigeration, and for storage of cans and pails, and at the same time insure sufficient working room.

The number and arrangement of the rooms depend upon practically the same considerations as the size. Except for a small dairy, producing cream, at least two rooms should be provided in the milk house, one for handling the milk from the cow to the market container and the other for washing and sterilizing the equipment. Additional rooms may be provided to meet individual needs, such as rooms for mechanical refrigeration machinery, ice box, straining vestibule, and office.

No rooms should be provided for human occupation as toilets or sleeping rooms, as they are unsanitary and are deemed nuisances by the law. This, however, does not prohibit a wash basin such as may be placed in the wash room or straining vestibule where the milker may wash his hands after milking each cow.

In planning, care should be taken to make certain that the house is large enough to care for a normal increase of the herd and that any likely changes in the methods of handling the product can be provided for enonomically.

CONSTRUCTION

Foundation and Floor.—Concrete makes an ideal material for the foundation and floor of the milk house, because it can be readily given any form desired, is not affected by the milk which may be spilled upon it, can be easily flushed off when properly sloped, and is permanent. As it is nearly always required as a flooring by city boards of health, all of the plans given here make use of it.*

Two general methods of constructing foundation footings and side wall forms are shown in figures 1 and 2. Footings of the type of figure 1 may prove somewhat easier to construct in loose soil. Less

* Valuable suggestions regarding the use of concrete may be secured from the Portland Cement Association, 785 Market street, San Francisco.

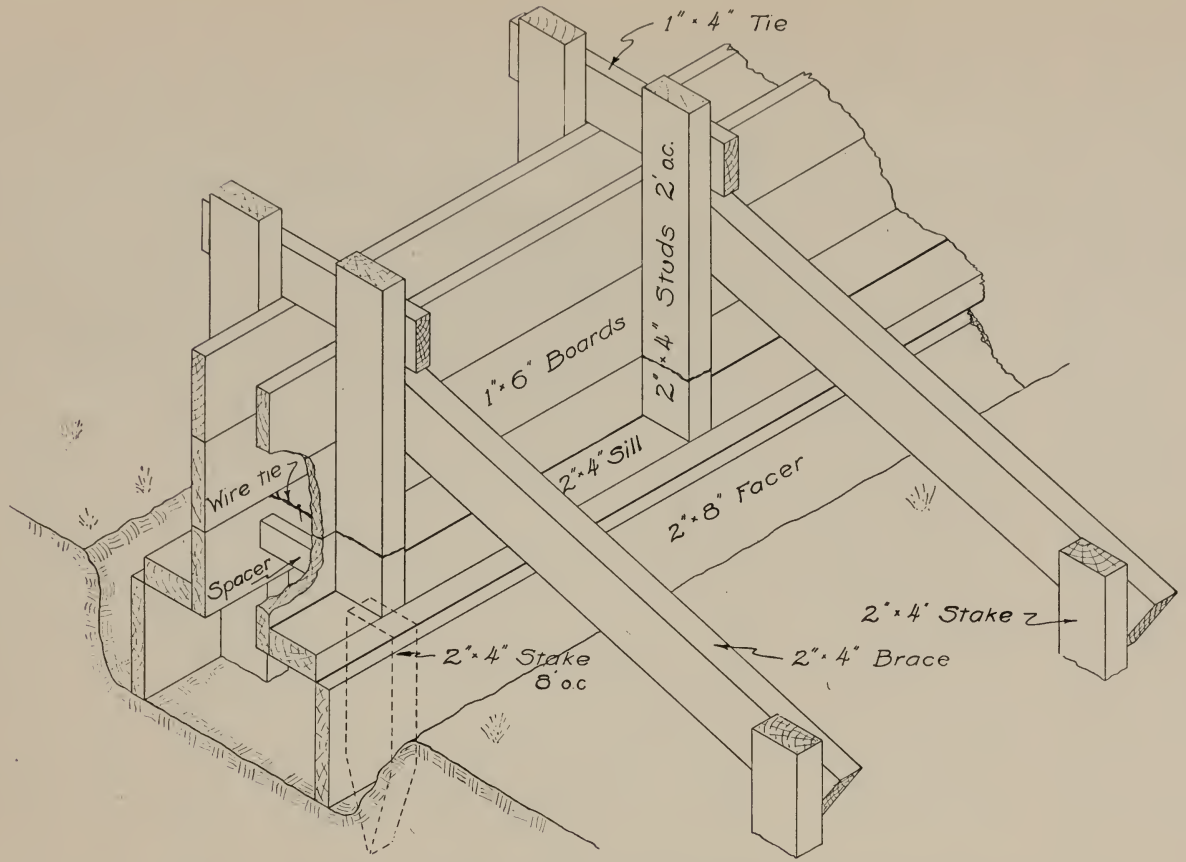


Fig. 1.—A form for rectangular concrete footing which will prove most satisfactory for use in loose soil. The footing trench should be dug deep enough that concrete may be placed on solid ground.

lumber and labor are necessary in the type of figure 2; less concrete also is required for the same effective base area. Either footing should extend down to solid ground or be broadened at the base to obtain greater bearing power. In regions subject to extreme cold weather the concrete should extend below the frost line.

Concrete blocks, tile blocks, or brick also make satisfactory foundations when correctly laid.

Door openings should be left in the concrete side wall. Some provision must be made, such as that shown in figure 3, for fastening the door jamb where a high concrete side wall is used.

For milk house construction all floors should be laid on a well drained surface at an elevation of at least four inches above the ground level. If a dirt fill is necessary, it should be thoroughly puddled and tamped to grade before the floor is laid. For two course work the first or base course should be 3″ to 3½″ thick, the top on finishing course ½″ to ¾″ thick. Care should be taken to obtain tight joints between the floor and walls by having the finishing course of the floor well rounded into the wall. This avoids sharp corners and facilitates cleaning. Sufficient slope should be given to the floor to insure good drainage. One-quarter inch to the foot is considered sufficient, provided an area of 18″ to 24″ in diameter about the floor drain trap is given a greater slope to quicken the flow of water at this point. Floor drain traps should be in a convenient location, but not so placed as to inconvenience the attendant working about the milk house. All markings in the floor should be in the direction of the slope, if possible.

If engines or heavy machinery requiring bases heavier than the floor are to be used, the extra concrete should be poured and the bolts set at the time of pouring the floor, or space should be blocked out to receive the bases later. All sink, cooling vat and floor drain traps, supply pipes, drains, and bolts which are partly or wholly imbedded in the concrete should be installed in the proper place before the concrete is poured.

Walls.—For a small dairy herd where the produce is handled as cream or whole milk, walls constructed in a way similar to that shown in figure 4 (A) are recommended. This consists of flooring laid vertically, face side in, over a light but substantial frame constructed of material surfaced on four sides. This makes a very satisfactory interior. All sills should be firmly imbedded in mortar and bolted securely to the concrete wall. A neatly trimmed mortar joint will prevent moisture from collecting under the sills.

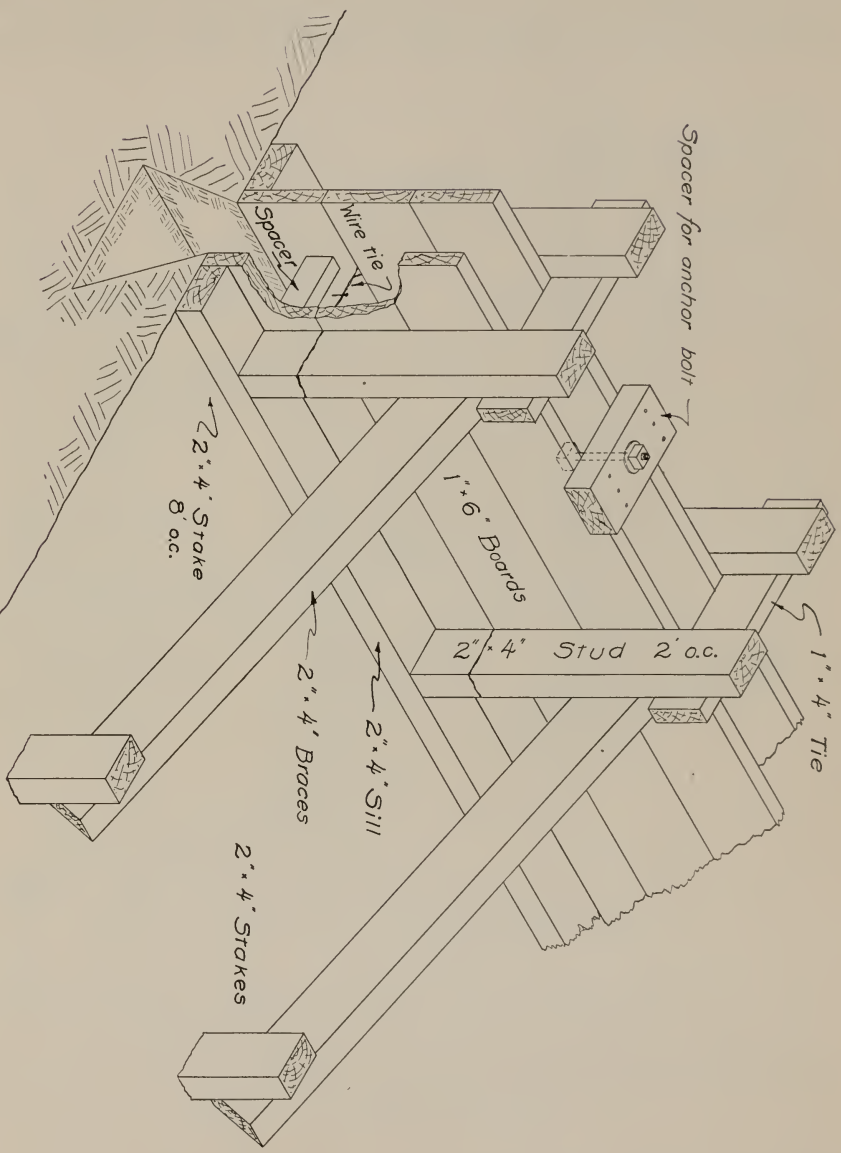


Fig. 2.—A common type of foundation which may be easily constructed on firm soil

Construction similar to figure 4 (B) is recommended when the interior of the milk room is ceiled with wood. All inside sheathing should be of well seasoned lumber with tongue and groove joints. Door and window casings, wainscot cap and other interior finish should be of plain surfaced stock preferably with rounded edges.

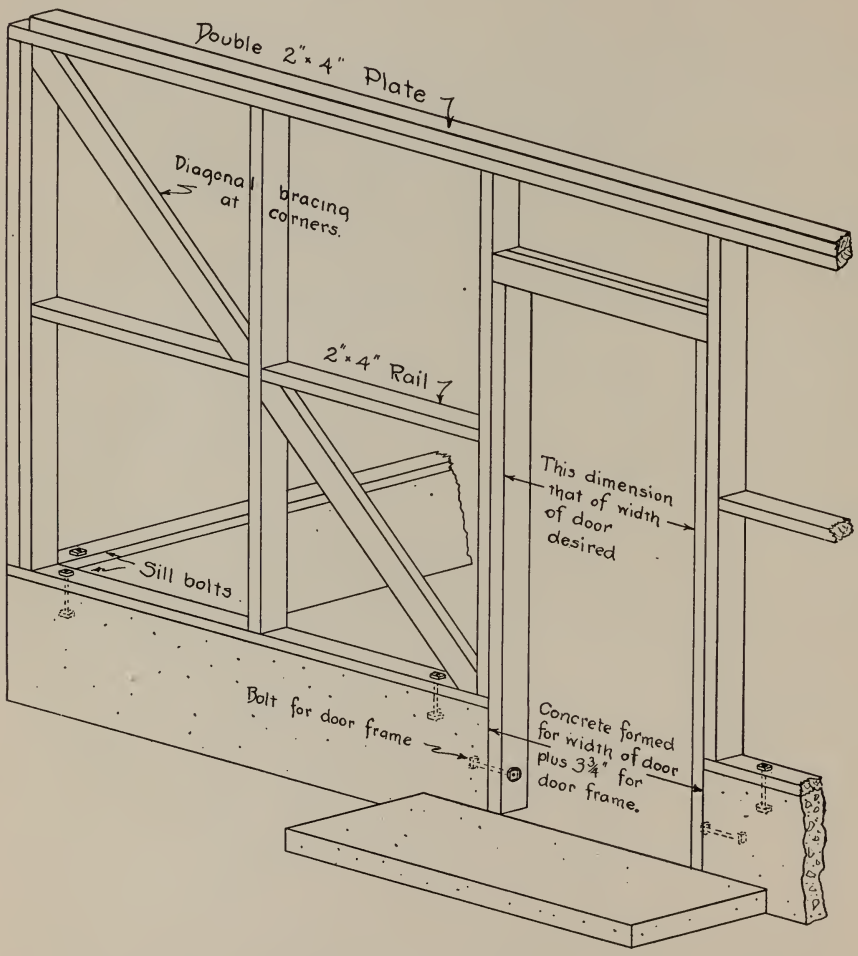

Double 2"×4" Plate
Diagonal bracing at corners.
2"×4" Rail
This dimension that of width of door desired
Sill bolts
Bolt for door frame
Concrete formed for width of door plus 3¾" for door frame.

Fig. 3.—Typical framing for small houses. Method of bracing and of bolting sill and door jamb to wall.

Projecting mouldings and casings for the house interior are dirt catchers and should be avoided where possible. For larger milk houses, with cement stucco or horizontal sheathing outside and cement plaster inside, construction similar to figure 4 (C) is recommended.

Roof.—A shed roof which is the least expensive is recommended for the smaller milk houses. The rafters and roof sheathing should be surfaced to facilitate interior cleanliness and painting. Prepared roofing of good quality wears well on a shed roof with a slight slope. It should be laid with the strips running up and down the slope of

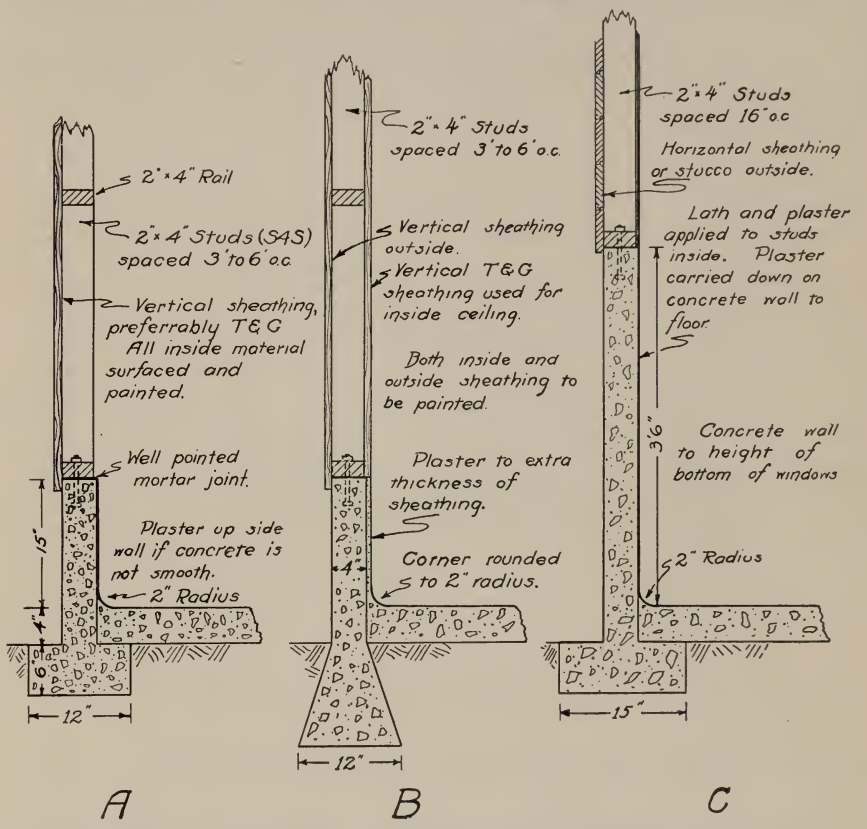

2"×4" Rail
2"×4" Studs (S4S) spaced 3' to 6' o.c.
Vertical sheathing, preferrably T&G All inside material surfaced and painted.
Well pointed mortar joint.
Plaster up side wall if concrete is not smooth.
2" Radius
15"
4"
6"
12"
2"×4" Studs spaced 3' to 6' o.c.
Vertical sheathing outside.
Vertical T&G sheathing used for inside ceiling.
Both inside and outside sheathing to be painted.
Plaster to extra thickness of sheathing.
Corner rounded to 2" radius.
4"
12"
2"×4" Studs spaced 16" o.c.
Horizontal sheathing or stucco outside.
Lath and plaster applied to studs inside. Plaster carried down on concrete wall to floor
3'6"
Concrete wall to height of bottom of windows
2" Radius
15"
A
B
C

Fig. 4.—Typical wall sections. Footings in A and C formed as by methods of Fig. 1; footing in B formed by method of Fig. 2.

the roof. All joints in the roofing should be thoroughly tarred and nailed and all ends carefully lapped over the facia boards and battened to prevent a strong wind from lifting the roofing. Prepared roofing is more durable if painted every second year with asphalt paint of a good quality.

Common pitch gable roofs are recommended for the larger milk houses. Shingles may well be used when the roof pitch is adequate to carry off the storm waters. A wood or plaster ceiling at a height equal to the height of the side wall is recommended for milk houses with gable roofs.

Doors and Windows.—There should be as few outside doors as possible in order to limit the cost of construction and the entrance of flies. For the latter reason it is usually best to have no outside entrance into the milk room but to enter it from a vestibule or the wash room. All outside screen doors and doors leading into the milk room should swing out, in order to prevent flies from entering with the attendant. This applies especially to the door to the straining vestibule, which should be placed at the bottom of the steps leading to the platform.

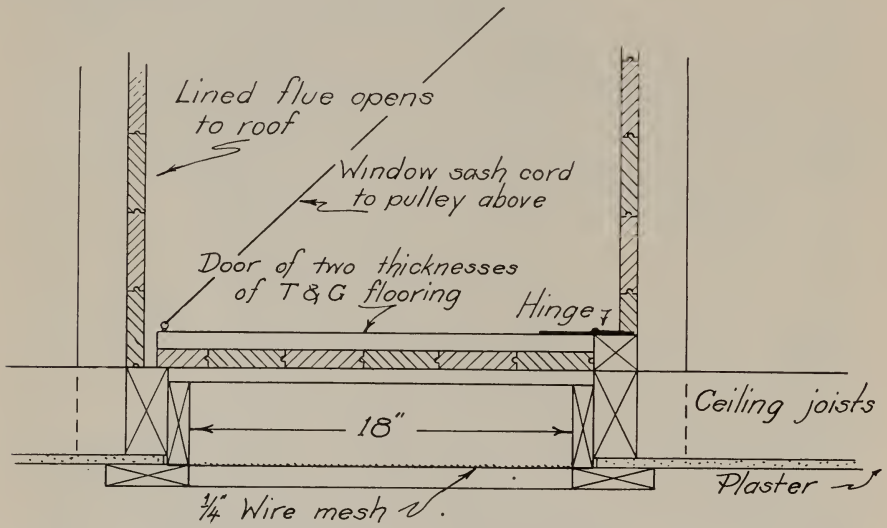


Fig. 5.—Detail of typical ceiling ventilator. Dimensions given for length and width of opening are for installations of average size.

Milk houses should have plenty of sunlight where possible. Window glass surface equivalent to ten per cent of the floor area is recommended. Counter-balanced double hung windows are recommended so that outside screens will not interfere with opening and closing the windows. All window screens should be hinged at the sides (not hung from the top) so that flies may be brushed out readily.

Door knobs and similar fittings should be porcelain or china, if possible. Such materials are cheap and are not affected by moisture.

Painting.—All outside woodwork should be painted with oil paint of good quality, to preserve the wood and make the building neat. The color may accord with that of the other farm buildings or may be white to promote cleanliness. Whitewash may be used but it does not preserve the wood. Stucco makes a very attractive exterior.

For the interior covering a hard plaster finish of Portland cement or painting the surfaced wood sheathing with a white, washable paint is recommended.

VENTILATION, ELECTRIC WIRING, PLUMBING, AND DRAINAGE

Steam and water are liable to make the milk house damp and hasten deterioration. Odors are likely to arise from spilled milk. Weather conditions in California are such that window and door openings properly arranged will provide a cross circulation of air for ventilation and will keep the interior of the milk house dry. In large milk houses it is usually advisable to have a central opening in the ceiling leading to a roof ventilator in both wash and milk rooms. Stock commercial ventilators are very satisfactory. A built-in ventilator is shown in figure 5. Screened openings approximately 6 inches by 14 inches through the outside wall and 3 inches above the floor assist in keeping the floor dry.

Electric Wiring.—The house should be wired to provide light in each room. This should be done by someone who understands electric wiring. One central ceiling fixture in each room will ordinarily be sufficient. A R.L.M. standard dome reflector and porcelain fittings are recommended for the severe moisture conditions of the milk house. To escape the danger of shorting through the bulb or key, the light should be controlled only by a switch placed on the side wall handy to a doorway. The ceiling fixtures should be fitted with keyless sockets. Especial attention should be given to these points, as the wet floors and moist atmosphere provide conditions favorable to severe electric shocks.

Plumbing.—Running water in abundance should be provided in the milk house for the purpose of keeping the house and utensils clean and the milk cool. At least one faucet should be provided in each room and hot water outlets from the boiler should be conveniently placed.

Similarly, drains should be provided to carry away surplus water, which should never be permitted to stand on the floor. All floor drains should be provided with bell traps such as that shown in figure 6 and all sinks, with the customary "S" traps.

Care should be taken in planning the plumbing to keep the pipes and drain tile as accessible as possible. If water pipes are hung on the walls and drain pipes run the shortest possible distance under the floor or foundation, much trouble may be avoided.

Drainage.—The milk house should be provided with a proper means of waste disposal. Milky water swept out of the milk house attracts flies and gives rise to disagreeable odors.

Waste from the floor traps and fixtures should be carried away from the milk house in a four or six inch pipe line, the first twenty

feet of which should be of sewer tile laid with tightly cemented joints on a grade of one-fourth inch to the foot. Local conditions govern the method of disposing of the waste from the milk house. The disposal line may be extended to the irrigation pipe line and the effluent flushed over the land at intervals of irrigation. It should not, however, be allowed to stand in an open irrigation ditch. Where soil conditions are such that good drainage is possible, four-inch standard drain tile is recommended laid with joints abutting and covered on top with burlap or tar paper to keep out loose earth. The arrangement of the tile after the first twenty feet of the line may be in the

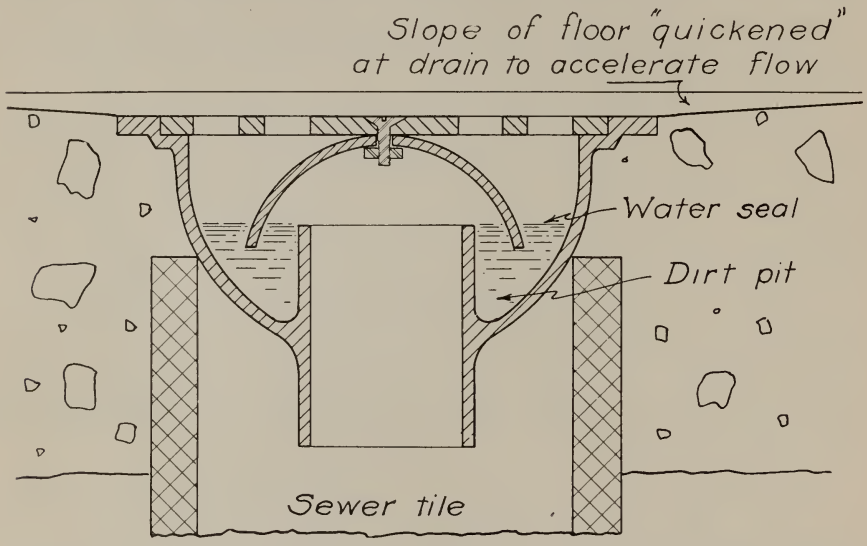


Fig. 6.—Cast iron cesspool with bell trap for floor drain. Such a trap is necessary to prevent dirt from entering the drain and odors from the drain entering the house. The bell of the sewer tile is chipped off to fit snugly against the cesspool. The bell end of the sewer tile joint should always be placed towards the source of the flow.

form of a three or four tined pitchfork to conserve space and assist, if desirable, in subsurface irrigation. The disposal line should have a fall of one inch to fifty feet and no one branch of the line should be longer than 100 feet.*

Under certain conditions the drain line may extend directly to a dug cesspool into which the liquid may be discharged, provided the seepage from the cesspool does not contaminate the supply of drinking water. A septic tank with open joint tile may be used for the disposal of the milk house wastes. Ordinarily it is not advisable to run the milk house disposal line to the residence septic tank.

* See University of California Circular No. 270, "A Farm Septic Tank."

OUTSIDE STRAINING PLATFORM OR VESTIBULE

By the use of the outside straining vat, the milk room may be kept more sanitary, less trouble will be had with flies, and a considerable saving will be made in labor. The straining vat which leads through the wall to the cooler or separator in the milk room is raised to a sufficient height to deliver the milk by gravity through the cooler or to a series of machines. Its height depends entirely upon the machinery to which the milk is delivered. A platform is ordinarily required under the vat to give the latter the desired height without necessitating an extreme lift to the straining vat. In order to save steps for the milker, the straining platform should be in the side of the milk room handiest to the milking barn.

Concrete platform and steps are recommended. They should be properly sloped for drainage to a floor trap. The concrete side wall next to the steps and platform should be carried up to twelve or fifteen inches above the platform to protect the woodwork of the outside wall. It should be formed with the other concrete walls and poured at the same time.

It is preferable to enclose the straining platform with materials similar to the exterior finish of the milk house or with screens, the door being placed at the foot of the steps leading to the straining vat platform. Some city health authorities require all new houses to be so constructed that the vestibule may be darkened during milking time.

Unless due precautions are taken, the wall-opening for the receiving vat may become a very unsanitary feature of the building. The receiving vat will have a spout to project through the wall of the house to the container within and in removing the vat some milk is certain to drip down inside the wall where it will decay and rot out the wooden frame. Furthermore, when the milk is poured into the vat, some of it may spill over and spatter the wall. As a protective measure, a sheet of galvanized iron may be placed against the outside sheathing extending down to the concrete, and the wall hole may be fitted with a three-inch galvanized iron pipe sloped to the inside and held in place by a screw flange at either end. As a precaution against flies, the straining vat should have a hinged cover which should be kept closed except when milk is being poured in it. Fig. 7 shows such an installation with typical measurements governing the height of the straining platform.

The straining vestibule makes a good place for the keeping of records if such are desired. For convenience in recording weights, scales and record sheet may be placed against the wall near the vat.

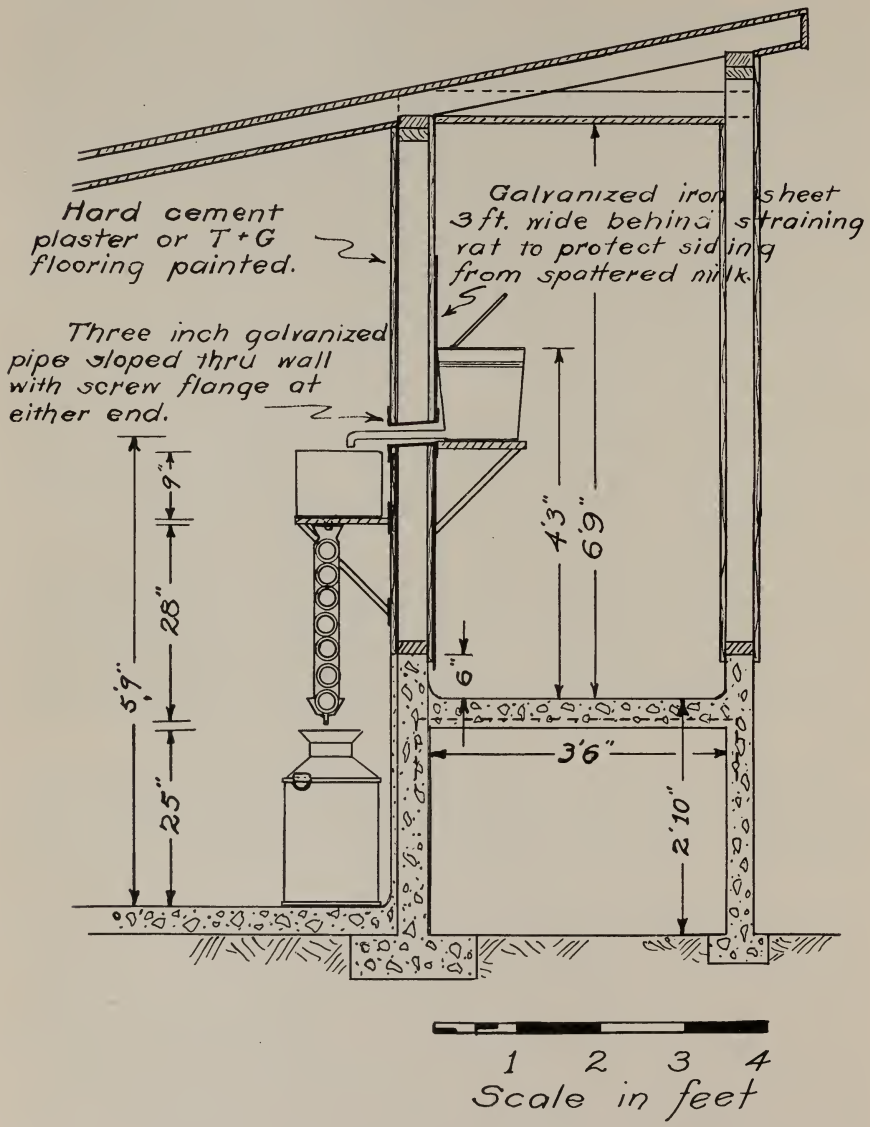


Fig. 7.—Section through front of shed roof house showing installation of straining vat. Dimensions of equipment are but indicative of dimensions which should be ascertained before constructing the platform and installing the vat.

REFRIGERATION

Both time and temperature influence the development of the bacteria which produce fermentation and thereby cause the milk to sour. For this reason it should be cooled as soon as possible after being drawn from the cow and should be held at as low a temperature as practicable until it is delivered to the consumer or to the creamery.

For such a program the dairyman must utilize some mechanical cooling device such as the tubular or the hopper cooler, a cold storage such as a cooling vat or cold room, and an insulated or iced conveyor to market.

The mechanical cooling device which will ordinarily be a commercial product, must be allotted space in the plan for the milk house. The cold storage will usually be built into the milk house. The choice between the cooling vat and the cold storage room depends upon the amount and the kind of product. Special considerations such as the use of a cold spring or a cheap supply of ice may effect the choice of the type of cold storage.

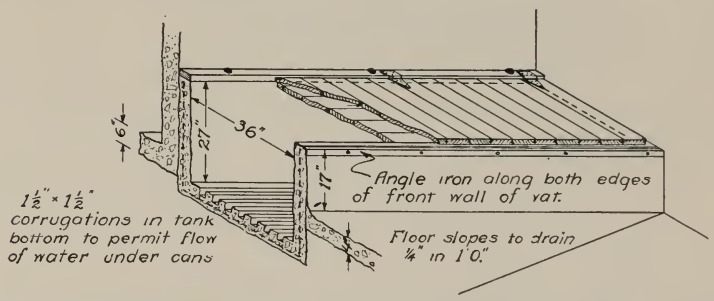

6½"
27"
36"
17"
Angle iron along both edges of front wall of vat.
1½" × 1½" corrugations in tank bottom to permit flow of water under cans
Floor slopes to drain ¼" in 1'0"

Fig. 8.—Section showing construction of concrete cooling vat. Covers of two thicknesses of 1″ × 6″ T & G hinged to 2″ × 4″ sill at back and overlapping 1″ on ends and front. Covers built in 3′ or 4′ lengths are more conveniently handled. Reinforcing of heavy hog wire fencing or ⅜″ steel bars spaced 12″ each way should be placed in walls and bottom as indicated by dotted lines.

Cooling Vats.—Cooling vats are tanks in which cans of cream or milk may be surrounded by water—preferably running water from well or spring—to cool and hold the product at about the temperature of the water or in cold climates to protect it from freezing. It is not intended to take the place of the initial cooling for market milk, which should be given as soon as possible after the milking. Cream placed in the cooling vat from the separator without the initial cooling should be stirred at intervals for two or three hours to facilitate the loss of the animal heat.

In most places in California water cold enough to hold the milk for twelve hours without an appreciable rise in bacterial count can be secured directly from a well.

For the simplest and yet most efficient circulation through the vat, the inlet pipe running direct from the well should discharge near the bottom and at one end of the vat, and the overflow drain should open near the top of the vat at the opposite end. In this way, the cold water enters at the bottom and rises toward the top as it takes up the heat from the cans. At the same time it is flowing from one end of the vat to the other around all the cans. The height of the overflow drain should be adjusted to hold the level of the water to within three inches of the top of the cans. Waste water from the cooling vat may be drained to the stock watering trough.

In some installations where it is difficult or impossible to secure water at the desired temperature, the vat is filled with water and ice cakes placed in it among the cans. Though this arrangement provides one solution of the cooling problem, it has the disadvantage of poor circulation—the cream is not cooled evenly without intermittent sttirring of the water in the vat. A better arrangement is to have a mechanical system wherein water is pumped over ice cakes and then through the vat, affording continuous circulation.

Figure 8 shows the construction of a concrete cooling vat, and table 1 gives the inside dimensions which should be used for vats of certain capacities.

TABLE 1

COOLING VAT; SIZES AND CAPACITIES

Number of 10-gal. cans	1	2	3	4	4	6	8	10
Capacity in gallons	10	20	30	40	40	60	80	100
Inside dimensions of vat of 27″ depth	20″×20″	20×36	20×54	20×72	36×36	36×54	36×72	36×84

Dairies requiring greater holding capacity than 100 gallons should ordinarily be provided with refrigeration rooms.

Concrete is recommended, as the vat is usually set in the ground twelve inches below the floor of the house to decrease the lift in handling the cans to and from the vat.

A four-inch wall and a four to six inch bottom of concrete will be sufficient for the vat. Additional strength may be provided by reinforcement placed around the corners of bottom and side wall. The concrete may be made watertight by using a 1:2:3 mix of good materials, properly spaded into place.

The vat may be provided with a tight wooden cover hinged to a sill bolted along the back edge of the vat. Such a cover will tend to hold the water at an even temperature. As shown in figure 8, angle irons set in the concrete on both corners of the front edge will protect the concrete from chipping off as the cans are moved into or out of the vat. A wooden sill may be bolted along the front edge for the same purpose, but this becomes water logged and fouled with spilled milk. The bottom of the vat should be formed with deep corrugations in the concrete or should be provided with a rack to afford water circulation under the cans. With some plans the rear and end walls may be poured as a part of the side walls of the building.

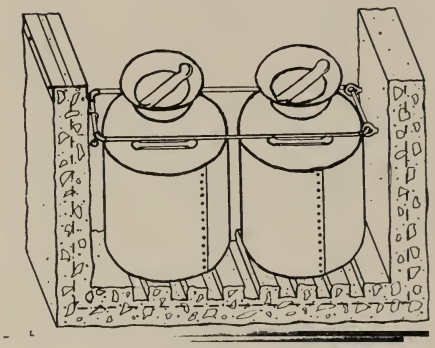


Fig. 9.—Section of concrete cooling vat. Device shown for holding partially filled cans in the vat. The eye bolts should be placed in rear wall of vat about 21 inches from the bottom according to the style of can used. Such a device for holding one or two cans submerged will be found a convenience readily included in any vat as constructed.

Some means should be provided for draining and cleaning the vat. A ground-joint, removable, standing overflow plug at the outlet end will be a great convenience in this respect. Such a plug is shown in figure 10. The height of the overflow may be adjusted to the desired depth of water about the cans and the entire vat may be drained by pulling the plug from the fitting set in the concrete bottom.

Cold Rooms.—For economy of insulating materials and in diminishing losses through wall conduction, the cold room or box should be made as small as practicable to care for the amount of produce to be handled. Refrigeration space may be desired for other farm produce, such as meat and eggs, but a separate box is recommended for these products in order that there may be no danger of contaminating the milk or other dairy products. An economy may be effected by constructing the two boxes together with a tight partition wall

which is not insulated. It is usually preferable to have an outside door into the meat box so that one need not enter through the milk house.

The design of the cold room depends to some extent upon whether the refrigeration is secured from ice or from mechanical refrigeration. For the former an outside icing door must be provided, and the cold

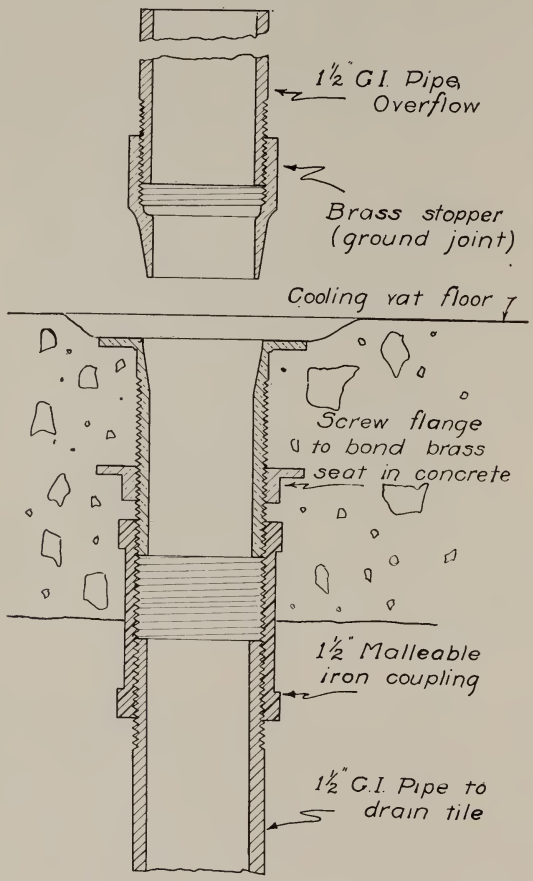

1½" G.I. Pipe Overflow
Brass stopper (ground joint)
Cooling vat floor
Screw flange to bond brass seat in concrete
1½" Malleable iron coupling
1½" G.I. Pipe to drain tile

Fig. 10.—Section of brass standing overflow with ground joint for concrete cooling vat. The G.I. (galvanized iron) pipe below the fitting drains into the sewer tile line from the floor drain. The overflow pipe above rises to the desired height of the water about the cans.

room increased in size to accommodate the ice bunker. For the latter, coils may be hung on the walls or ceiling, but the cold room must be located as near as possible to the refrigerating machinery in the machine room.

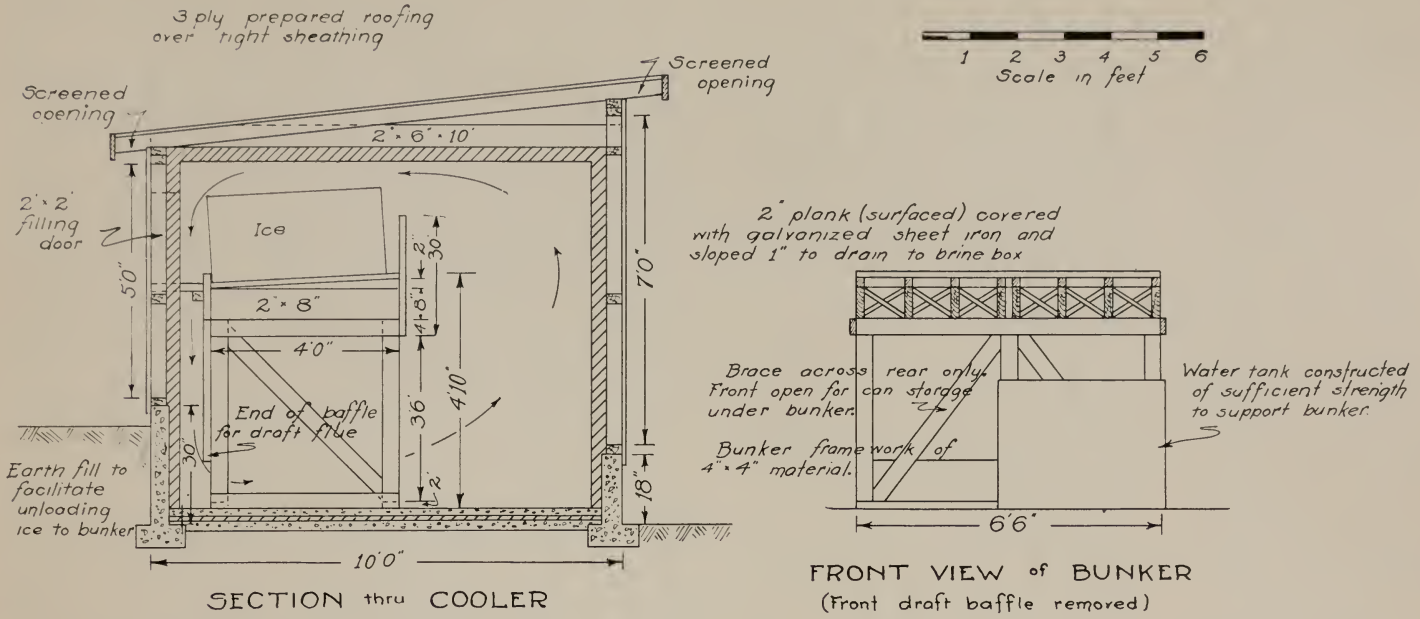


Fig. 11.—Typical cold room installation in shed roof house. For ice cooling, the arrows about ice bunker in room section indicate the air currents set up in the room. For least disturbance of these currents the door opening into the room should be in the wall at the end of the bunker rather than in the front wall. The box furnishes a supply of cold water or brine for the preliminary cooling of the milk by mechanical means.

No window is necessary in the cold room but an electric light is useful. To prevent refrigeration losses, all unnecessary openings should be omitted. One large door into the cold room is usually sufficient though a small door for passing bottles or cans of milk out to the loading platform is sometimes convenient. The large door should be so placed with reference to the ice bunker or expansion coils that they are against the wall which is at right angles to the one containing the door opening. In this position the door interferes least with the circulation currents in the cold room.

Special care is necessary in the construction of the doors to prevent them from warping or binding. A poorly fitting door that allows the outside air to enter the cold room or that opens or closes with such difficulty as to tempt the attendant entering to leave it ajar is a constant source of loss. Usually it is economy to purchase a commercial door of good design.

Insulation.—There is no known material that will entirely prevent the passage of heat. The most efficient heat insulators are those with the greatest amount of entrapped air confined in the smallest possible air spaces. Air transmits heat rapidly when permitted to move freely but when confined in small spaces where it must transmit heat by conduction rather than by convection, it serves as an excellent insulator.

There are other requisites for a good insulator, however, than its primary insulating value. The ability to retain its insulating efficiency indefinitely, uniformity of insulating value, resistance to moisture, structural strength, fire proofing and rodent harboring qualities, space occupied, waterproof surface for interior of box, as well as exterior, first cost, and cost of installing, upkeep and depreciation are all factors to consider in selecting the insulating material.

Cold storage boxes are sometimes constructed of boards in combination with air spaces, but while ordinarily cheap in first cost this type of refrigeration is not recommended. It does not constitute an efficient insulation and the wooden construction sooner or later checks or swells under the trying moisture conditions, and the wall shows increased losses.

Sawdust and planing mill shavings are perhaps the materials most readily accessible for farm insulating purposes in this state, but they are not considered the best. It is difficult to get a construction that will keep them dry; they settle badly unless properly framed with supporting rails at every two or three feet of wall height; they are not fire proof; and they furnish a harbor for rodents. The planing mill shavings are better for insulating purposes than sawdust, in that

they do not settle so rapidly, do not absorb moisture so readily as sawdust and, most important, can usually be had in a very dry condition.

For large dairies or for high class construction, one of the standard commercial insulating materials is recommended. Some of the commercial products that are recommended for this type of insulating are hair felt or hair quilt, flax fiber, mineral wool, straw board, lith blocks, granulated cork, and sheet cork. Any of these materials will prove satisfactory in excluding heat from the cold room, provided that a sufficient thickness of the material is used and that the plan and workmanship of the construction are good. Ordinarily, three inches of sheet cork or its equivalent is satisfactory. In using loose material between the studs, horizontal retaining rails should be built at about three foot spacings to prevent the weight of the material from packing it and settling from the top. Waterproof paper should be used on both sides of the wall to prevent moisture from entering the insulator. Insulation blocks should fit tight together and should be cemented on the back rather than at the joints. A one-half inch thick Portland cement plaster finish, applied in two coats directly to the face of the insulation blocks forms a very satisfactory interior finish.

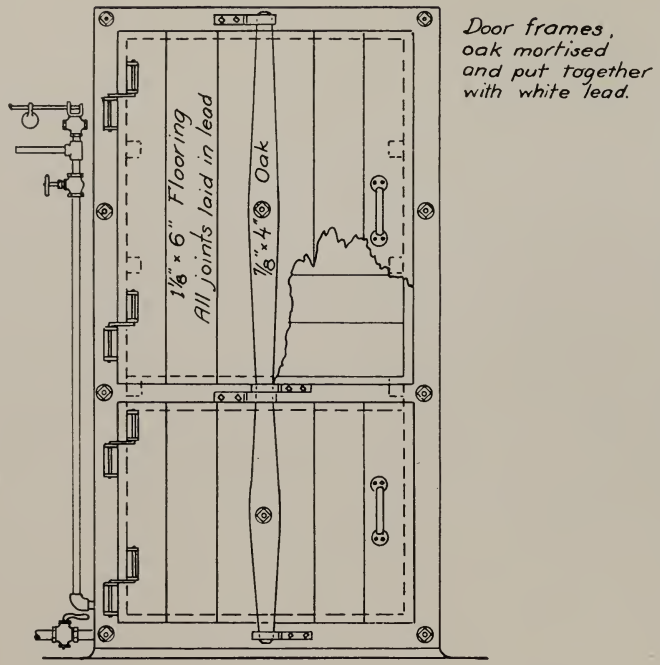
Concrete should be used for the floor of the cold room and should contain approximately one-half the amount of insulation used in the walls. If the wall insulation consists of blocks, the same material may be laid in the floor protected on both surfaces by asphalt poured hot. Blocks of hollow concrete or clay tile constitute a good floor insulating material as well as a good construction material for the walls.

Intelligent planning is required to balance the design of the cold room and insulation with the refrigeration equipment. The advice of a competent refrigeration engineer should be sought regarding the installation. Refrigeration machinery companies maintain engigineers to coöperate in properly installing their equipment.

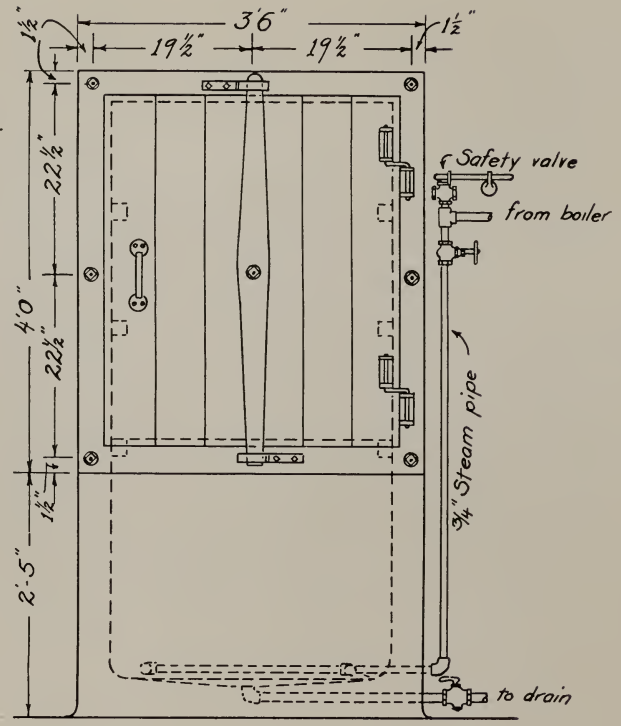
STERILIZERS

To produce milk low in bacterial count, especial attention must be given to the sterilization of the milk containers and apparatus.

For small dairies this may be economically achieved by boiling water and sunlight, but for larger dairies sterilization with live steam is recommended. Very satisfactory galvanized iron sterilizers can be purchased from most of the dairy equipment supply houses in the

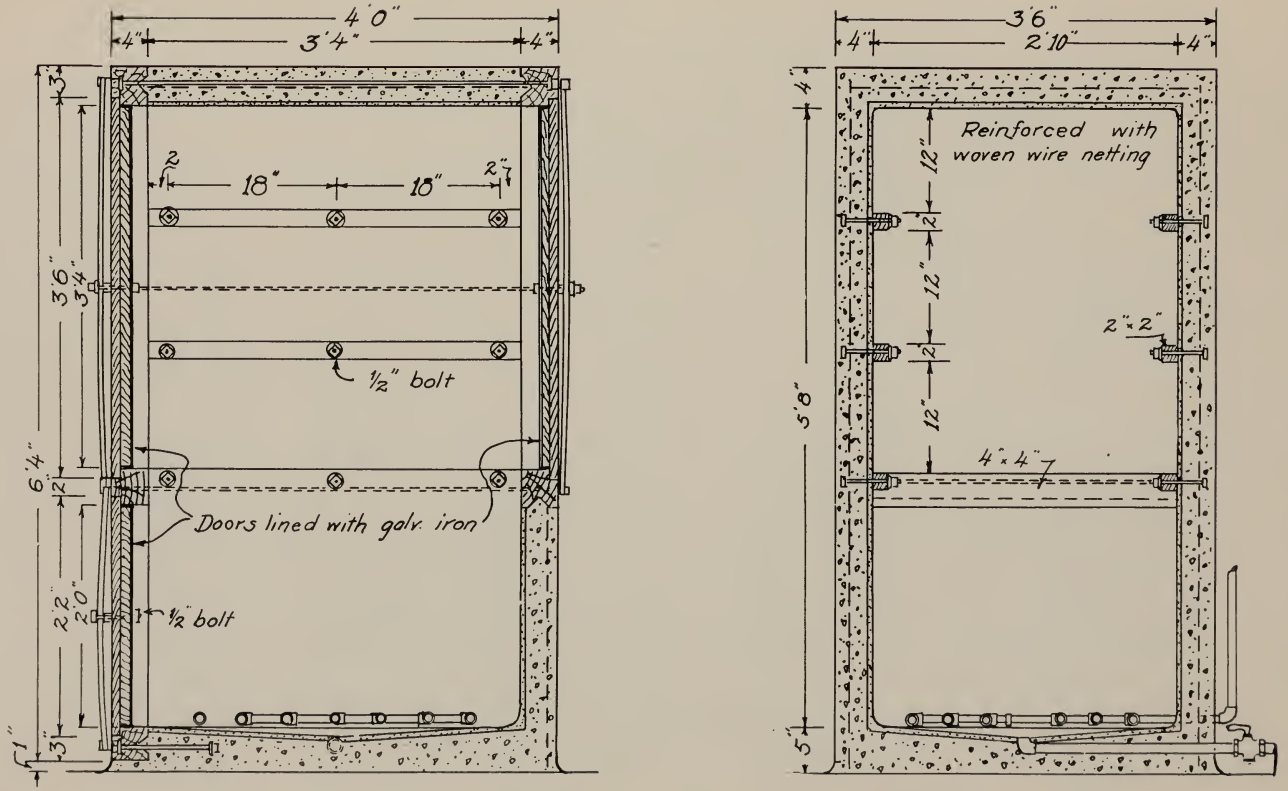


END VIEW.
(Opening into wash room.)



END VIEW
(Opening into bottling room)

(After U.S.D.A. Plan B-452)



(After U.S.D.A. Plan B-452)

Fig. 12.—Sections and elevations of a concrete sterilizer. This sterilizer is to be built between the wash room and milk room with a door opening into either.

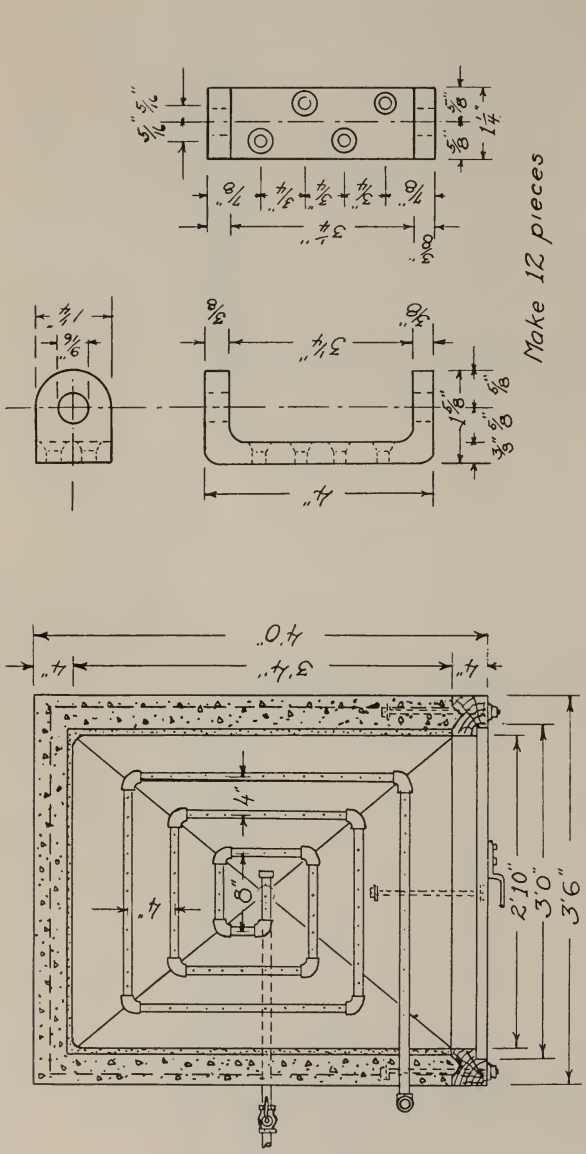


Fig. 13.—Section and hinge details for concrete sterilizer. In Fig. 12 is shown the arrangement of the steam pipes in the bottom of the sections. Steam is provided by a boiler located nearby. Special hinges as shown are required for the doors.

state. For installations demanding special shape, size, or other special features, sterilizers of this material can be made to order at very moderate prices. Where properly taken care of, galvanized iron for this purpose is durable and satisfactory.

Permanent built-in installations are also coming into favor, and when well designed and constructed are more sanitary and economical of labor. For enonomy of labor the sterilizer may be placed in the wall between wash room and milk room with a door opening into either or just outside the washroom with a door opening through the wall.

Reinforced concrete is excellent for the built-in sterilizer. Figures 12 and 13 give plans for a sterilizer of this material. The concrete mixture should be 1 part of cement, 2½ parts of sand, and 4 parts of crushed rock just wet enough to produce a workable mix and tamped in place. All of the concrete should be poured at one time to prevent juncture cracks in the completed walls. The reinforcing should be of heavy woven wire fencing placed 1½ inches from the outside of the walls and a like distance from the bottom of the top slab.

Bolts for the wooden slide ways and the oak door jambs and the steam and drain pipes should be placed before pouring. The steam openings are placed at the bottom of the sterilizer as shown, and the drain line is provided with a shut-off valve. The doors are constructed of two thicknesses of 1″ × 6″ flooring with the joints painted with white lead and covered on the inside with galvanized iron. The oak door frames should be painted before being placed in position, and all exposed portions of woodwork should be similarly treated.

Removable angle iron racks may be placed on the wooden slideways to carry the bottle containers. Milking buckets and cans may be sterilized in the lower compartment immediately above the inlet pipes.

MILK HOUSE PLANS

Pictorial drawings and suggested floor plans for five sizes of milk houses are given herewith. Publications containing complete plans, specifications and bills of material for each individual size of house may be secured as noted in the description. It is not expected that any one plan will entirely satisfy the requirements of all constructions of that size. It is believed, however, that a study of the plans will enable a dairyman to build more economically and better.

The bill of materials given in each plan circular enables a prospective builder to determine the cost of the materials before starting

construction. A few directions and comments on the construction of each house are given with the drawings which should enable any rancher who has had some building experience to construct the smaller types without assistance.

All of the houses have been designed of a size sufficiently large to economically contain the equipment which it is believed will be required to care for the production from the herd stated for that size house. However, commercial equipment may vary considerably in size and shape so if some of the equipment is already at hand or has been decided upon, it would be well to secure its overall dimensions and compare with the space allotted to that equipment on the plan before commencing building operations. In purchasing equipment after the house is built it would be well to ascertain on the plan the space required for each piece before purchase is made.

Printed plans, specifications and bills of material for any of these types of milk houses will be supplied on application to the Division of Agricultural Engineering, University Farm, Davis, California. Request should be made for such of the following as is desired.

MILK HOUSE PLANS

Plan Series A—No. 1—Small Milk Houses for Cream Production from Small Dairy Herds.

Plan Series A—No. 2—A 6 ft. × 16 ft. Milk House for Milk or Cream.

Plan Series A—No. 3—A 10 ft. × 16 ft. General Purpose Milk House.

Plan Series A—No. 4—A 12 ft. × 18 ft. Milk House for Medium Sized Dairies.

Plan Series A—No. 5—A 20 ft. × 32 ft. Milk House for Large Dairies.

PLAN SERIES A—NO. 1

SMALL MILK HOUSES FOR CREAM PRODUCTION FROM SMALL DAIRY HERDS

For the smallest dairies a 6 ft. × 6 ft. or an 8 ft. × 8 ft. milk house will serve. Sufficient but not extensive working space has been provided in the 6 ft. × 6 ft. house, which is designed to care for the cream production from a herd of ten to fifteen cows.

The small circled numbers on the plan refer to:

1. Drain rack of galvanized iron.
2. Concrete cooling vat.
3. Ten-gallon milk cans.
4. Table extending over end of vat.
5. Cream separator.
6. Drain.
7. Sliding sash.
8. Door.
9. Screen door.

The estimated cost of construction for this house including built-in equipment is $75.00.

For the dairyman desiring a larger floor area than that shown in the 6 ft. × 6 ft. house and one in which a sink and sterilizer may be installed, an 8 ft. × 8 ft. house is recommended.

The estimated cost of construction for the 8 ft. × 8 ft. house including built-in equipment is $90.00.

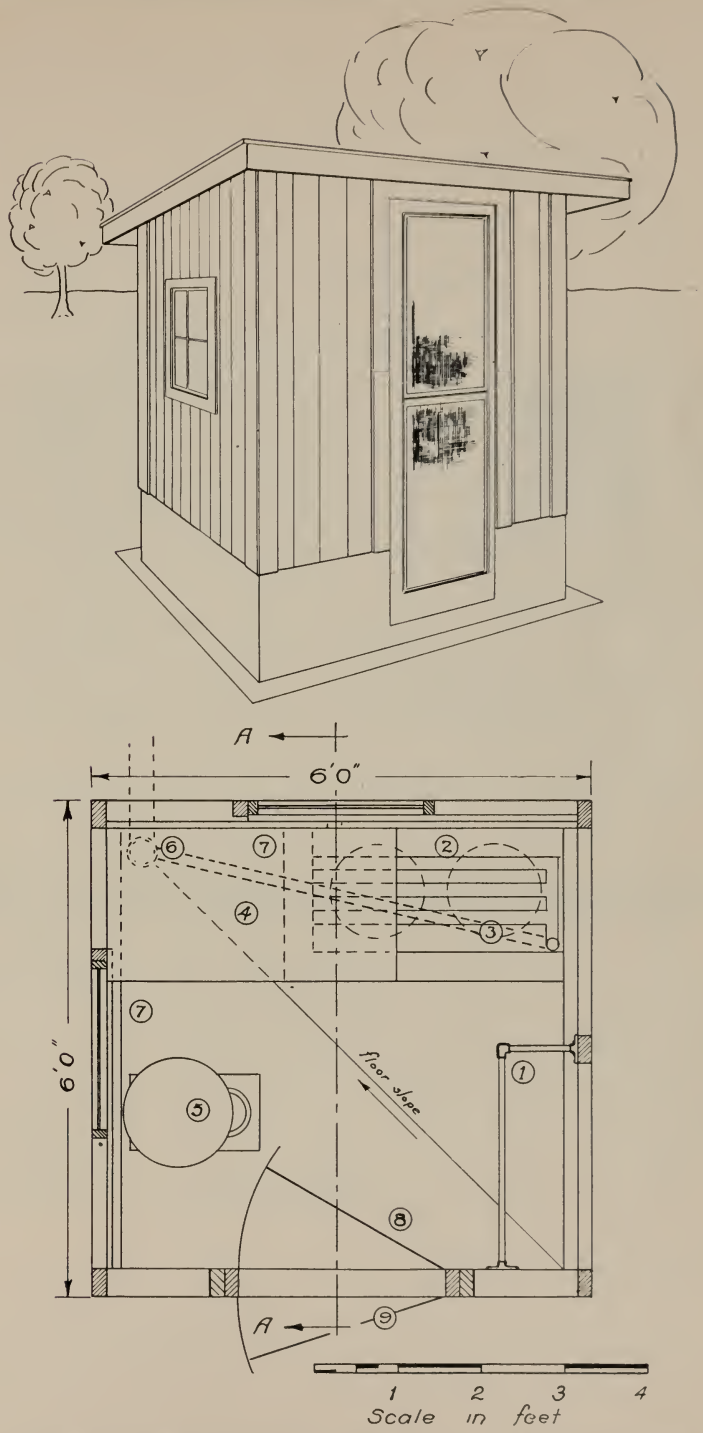


Fig. 14.—Perspective and floor plan of 6 ft. × 6 ft. milk house.

PLAN SERIES A—NO. 2

A 6 FT. × 16 FT. MILK HOUSE FOR MILK OR CREAM

For dairies of 15 to 20 cows, a 6 ft. × 16 ft. milk house will be found a very satisfactory size. The plan of that size shown here in a two room, shed roof type of house for cream production. The equipment may be changed to care for whole milk. The framing is designed for vertical sheathing of flooring. The house is not sheathed inside, although the plan may be readily modified for wooden sheating or for plaster.

The floor plan will readily accommodate equipment as shown:

1. Wash sink and drain board placed before screened opening.
2. Sterilizer of galvanized iron with oil burner.
3. Concrete cooling vat to hold three 10-gallon cans.
4. Tubular cooler connected in water line.
5. Table for holding pails and equipment.
6. Can drain rack of galvanized iron pipe placed over the table.

But one outside door is provided, and this opens into the washroom. This feature aids in keeping the milk room free from flies. Cross light and ventilation are provided in the milk room by using a sash door to the washroom and placing a double hung window in the front and one in a side wall. Both windows must be screened. The door opening to the wash room is screened, and the entire front of the room above the wash sink is open and screened.

The estimated cost of the house as shown, exclusive of equipment, is $150.00.

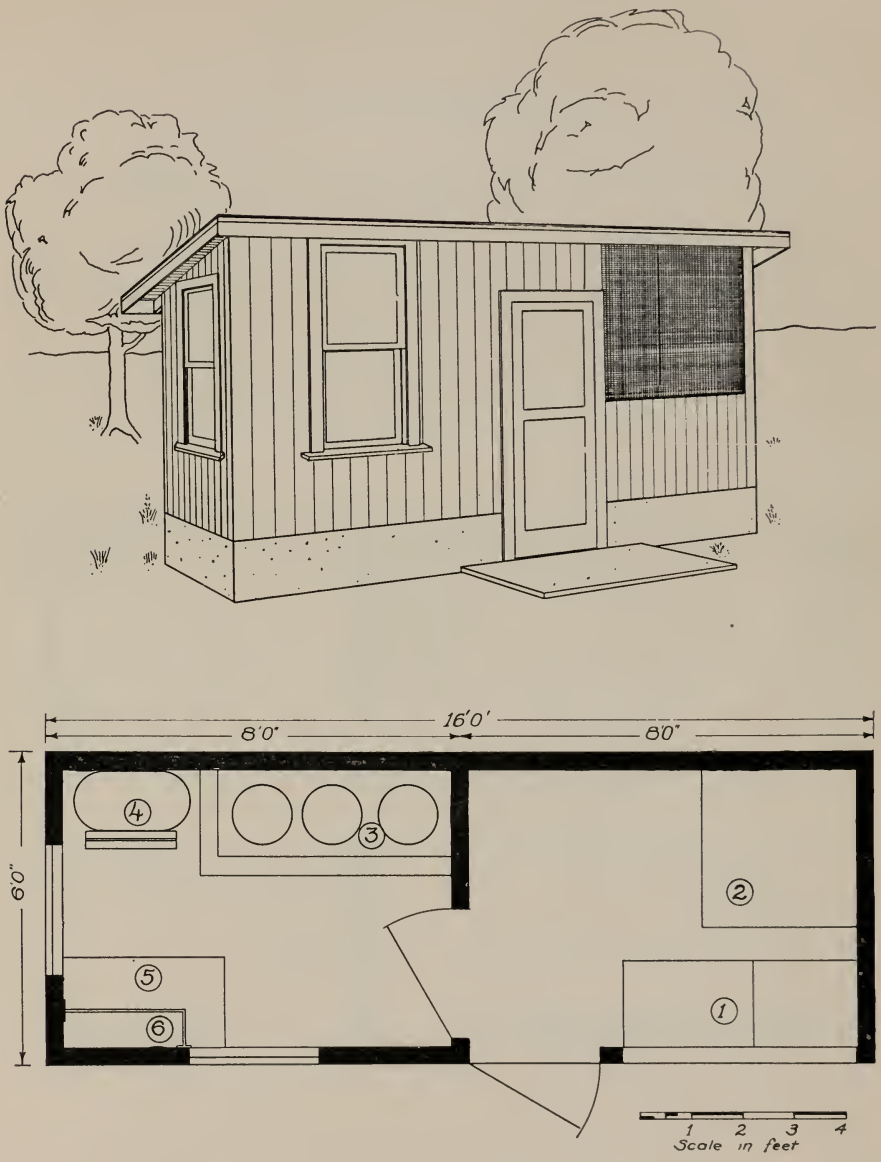


Fig. 15.—Perspective and floor plan of 6 ft. × 16 ft. milk house.

PLAN SERIES A—NO. 3

A 10 FT. × 16 FT. GENERAL PURPOSE MILK HOUSE

The third house in this series has been designed in a 10 ft. × 16 ft. size and is estimated to be sufficiently large to care for the production from a herd of approximately 30 to 40 cows.

As in most of the other plans, distinct rooms are provided for the care of the milk and for the washing and sterilizing processes. The plan also provides for a straining platform which becomes very desirable for a herd of this size.

Besides the floor plan as shown, the plan circular suggests three optional arrangements. All utilize the same general construction and size but vary to accommodate different equipment. In the arrangement shown, the milk room is equipped for cream production.

The framing for the vertical siding of flooring and the shed roof of prepared roofing as suggested in this plan is economical. A more elaborate one, however, may be used at the option of the dairyman.

The erection cost of this house will be approximately $300.00.

The numbers on the floor plan indicate:

1. Straining vat with opening through wall to milk room.
2. Holding vat.
3. Separator.
4. Can drain rack of galvanized iron pipe.
5. Concrete cooling vat to hold two 10-gallon cans.
6. Table.
7. Sterilizer of galvanized iron with oil burner.
8. Drain board.
9. Wash sink.

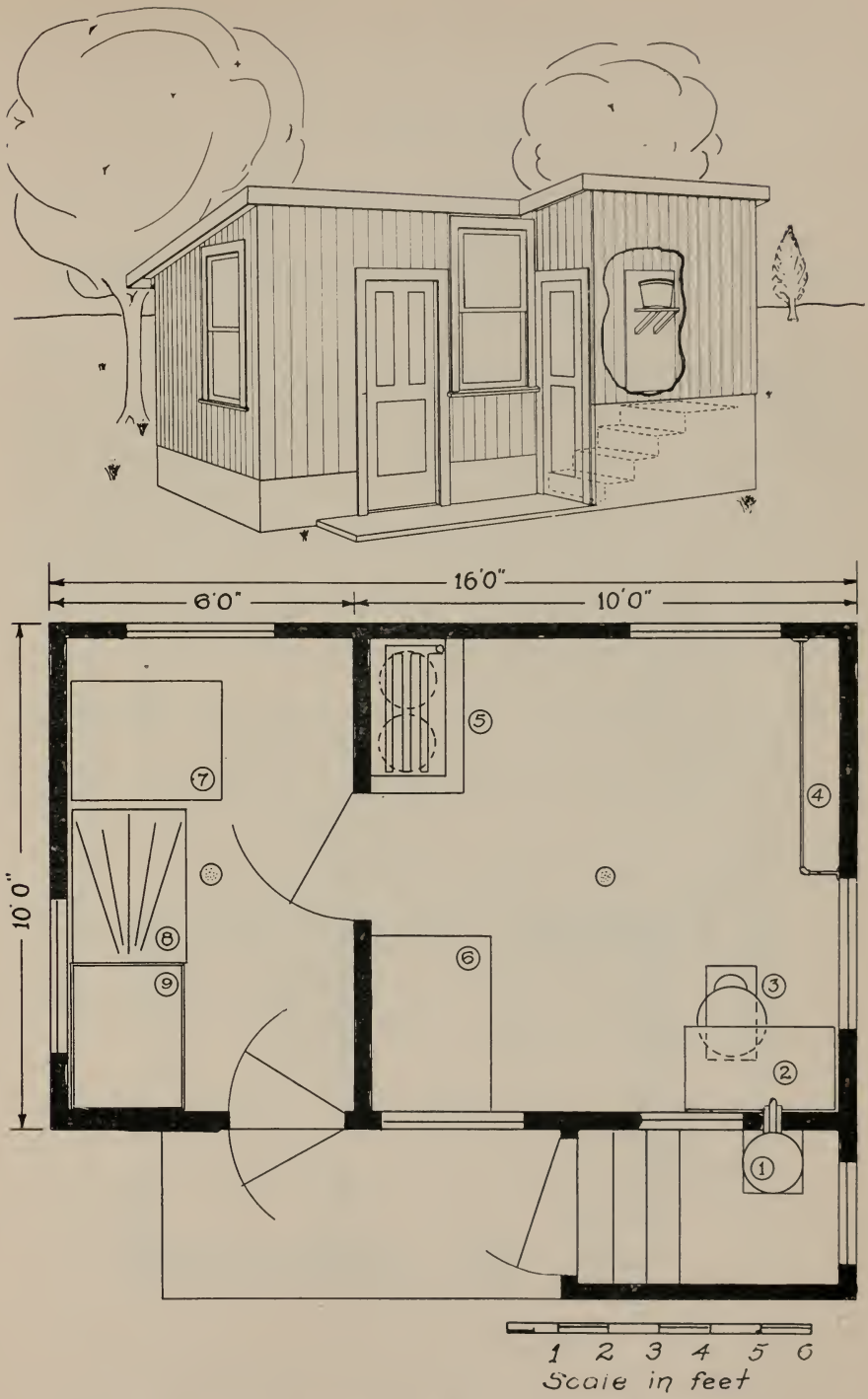


Fig. 16.—Perspective and floor plan for 10 ft. × 16 ft. milk house.

PLAN SERIES A—NO. 4

A 12 FT. × 18 FT. MILK HOUSE FOR MEDIUM SIZED DAIRIES

The main dimensions of this milk house are 12 ft. × 18 ft. which include the milk room and the combined boiler and wash room. A straining room and delivery shed are attached and constitute integral parts of the plan. The house is designed to care for the produce from a herd of 50 to 90 cows according to the manner in which the produce is marketed and the equipment in the house. Constructed with concrete floor and 3-foot side wall with the frame wall above plastered inside, and a shingled gable roof, the cost of construction is estimated as approximately $800.00, exclusive of equipment.

The numbers shown on the plan indicate:

1. Straining room with 4′ × 4′ concrete platform.
2. Tubular cooler with wall opening to straining vat.
3. Bottler.
4. Separator.
5. Refrigerator of 3′ 4″ × 5′ 6″ inside measurements. Provided with overhead ice bunkers.
6. 2′ 8″ × 6′ 8″ sliding door with screen.
7. 2′ 8″ × 6′ 8″ sliding door with glass panel.
8. Testing table with apparatus cabinet on wall.
9. 2′ 8″ × 6′ 8″ O.G. door with screen.
10. Sink and drain board.
11. Sterilizer.
12. Boiler.
13. Fuel oil drum.
14. 2′ 6″ × 6′ 8″ screen door.
15. 2′ 0″ × 5′ 1″ D.H. windows with screens.
16. 2′ 6″ × 5′ 1″ D.H. windows with screens.

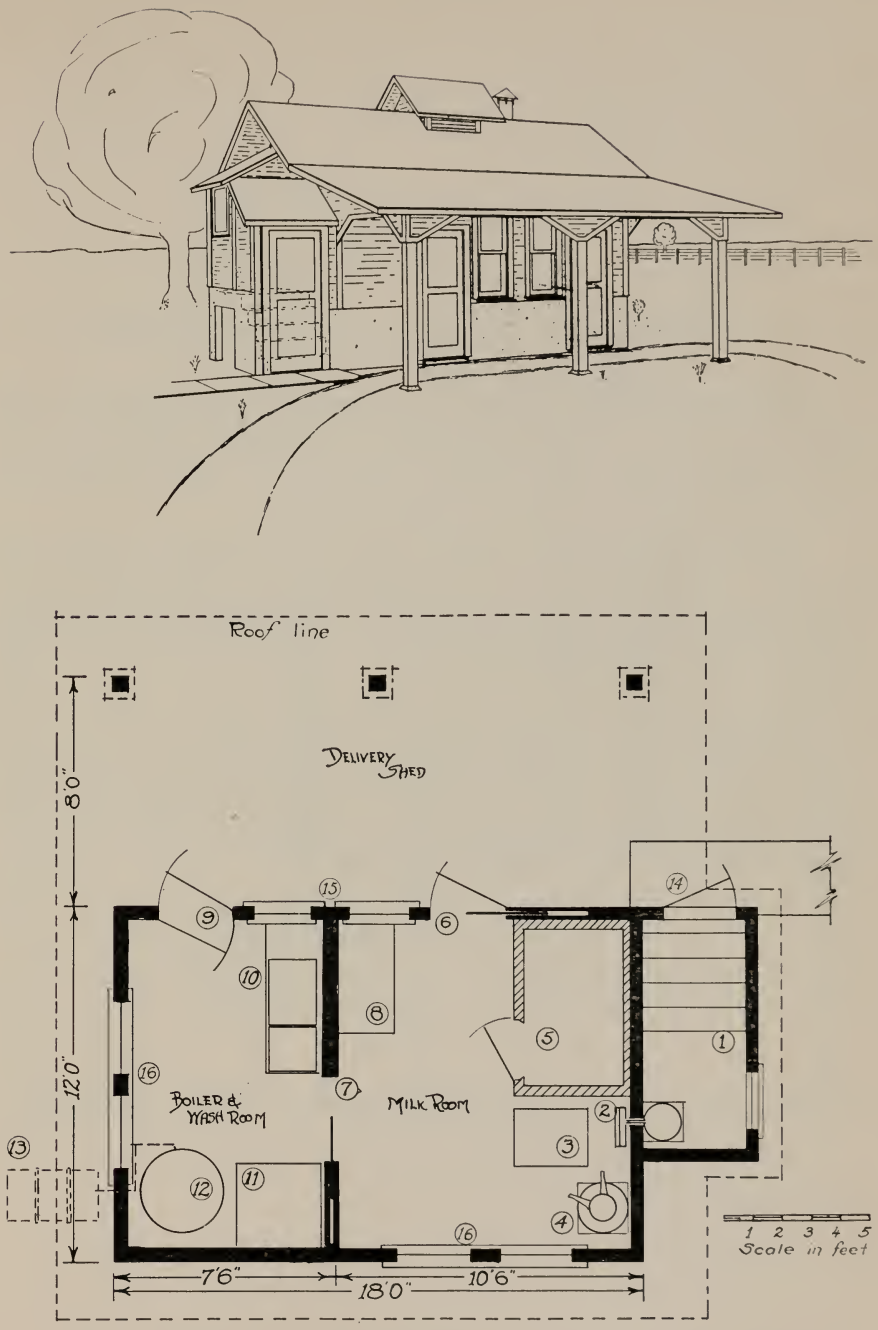


Fig. 17.—Perspective and floor plan of 12 ft. × 18 ft. milk house.

PLAN SERIES A—NO. 5

A 20 FT. × 32 FT. MILK HOUSE FOR LARGE DAIRIES

This house has been planned for the dairy having a herd of from 100 to 200 cows. It is 20 ft. × 32 ft. and may be used at the end of the milking barn (see standard University of California Plan No. C–28) with a covered drive between if desired.

Several arrangements for this floor area are given in the plan circular. The plan shown on the opposite page includes a milk room, wash room, separate cold rooms for milk and meat, built-in sterilizer, and straining room. The perspective shown here is for a floor plan given in the plan circular.

The house has a concrete floor and a 3-foot side wall with a wood frame above. This is shown sheathed on the outside with horizontal rustic and lathed and plastered inside. A one-fourth pitch shingled gable roof is shown. The cost of the house exclusive of any equipment is estimated to be approximately $1500.00.

The numbers shown on the plan indicate:

1. Boiler.
2. Wash sink and drain board.
3. Built-in sterilizer.
4. Straining platform.
5. Refrigeration machinery and equipment.

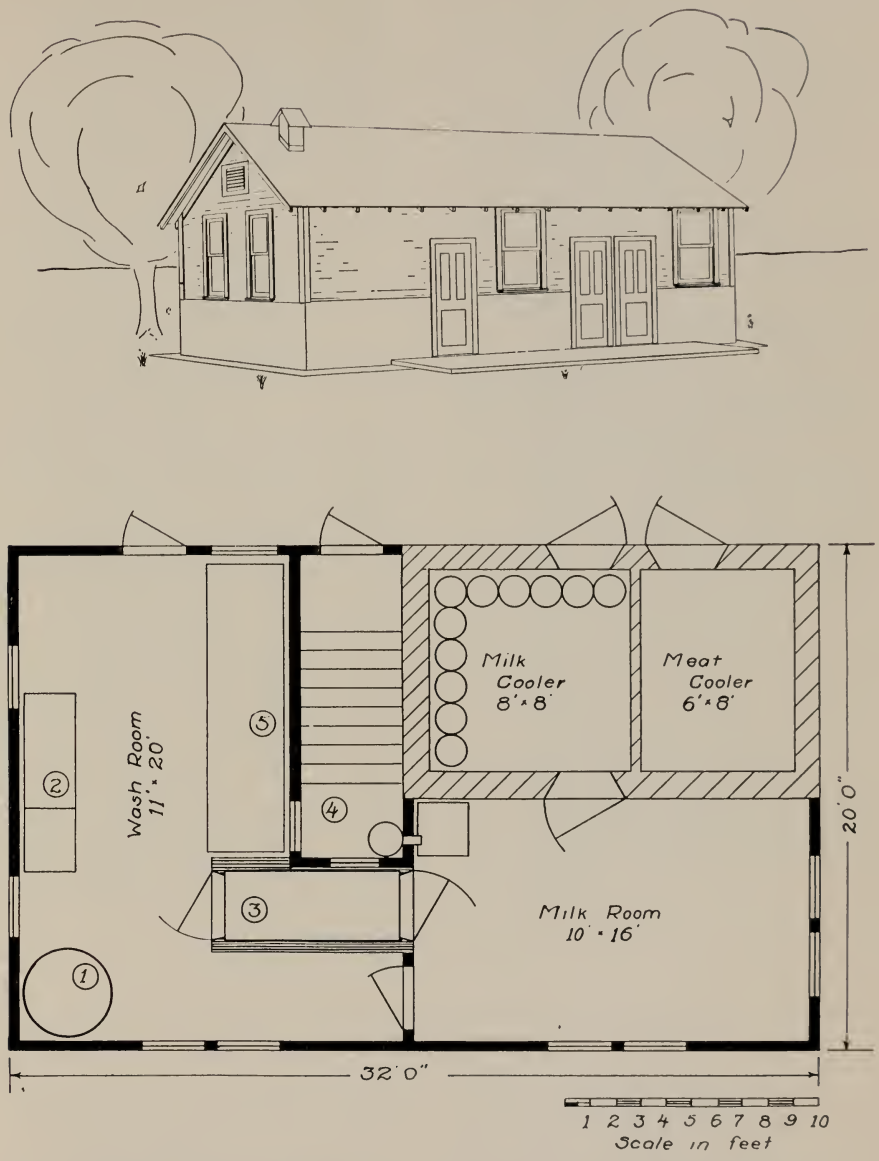


Fig. 18.—Perspective and floor plan of 20 ft. × 32 ft. milk house.

STATION PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION

BULLETINS

No.

253. Irrigation and Soil Conditions in the Sierra Nevada Foothills, California.
261. Melaxuma of the Walnut, "Juglans regia."
262. Citrus Diseases of Florida and Cuba Compared with Those of California.
263. Size Grades for Ripe Olives.
268. Growing and Grafting Olive Seedlings.
273. Preliminary Report on Kearney Vineyard Experimental Drain.
275. The Cultivation of Belladonna in California.
276. The Pomegranate.
277. Sudan Grass
278. Grain Sorghums.
279. Irrigation of Rice in California.
280. Irrigation of Alfalfa in the Sacramento Valley.
283. The Olive Insects of California.
285. The Milk Goat in California.
286. Commercial Fertilizers.
294. Bean Culture in California.
304. A Study of the Effects of Freezes on Citrus in California.
310. Plum Pollination.
312. Mariout Barley.
313. Pruning Young Deciduous Fruit Trees.
319. Caprifigs and Caprification.
324. Storage of Perishable Fruit at Freezing Temperatures.
325. Rice Irrigation Measurements and Experiments in Sacramento Valley, 1914–1919.
328. Prune Growing in California.
331. Phylloxera-Resistant Stocks.
334. Preliminary Volume Tables for Second-Growth Redwood.
335. Cocoanut Meal as a Feed for Dairy Cows and Other Livestock.
339. The Relative Cost of Making Logs from Small and Large Timber.
340. Control of the Pocket Gopher in California.
343. Cheese Pests and Their Control.
344. Cold Storage as an Aid to the Marketing of Plums.
346. Almond Pollination.
347. The Control of Red Spiders in Deciduous Orchards.
348. Pruning Young Olive Trees.
349. A Study of Sidedraft and Tractor Hitches.
350. Agriculture in Cut-over Redwood Lands.

No.

352. Further Experiments in Plum Pollination.
353. Bovine Infectious Abortion.
354. Results of Rice Experiments in 1922.
357. A Self-mixing Dusting Machine for Applying Dry Insecticides and Fungicides.
358. Black Measles, Water Berries, and Related Vine Troubles.
359. Fruit Beverage Investigations.
361. Preliminary Yield Tables for Second Growth Redwood.
362. Dust and the Tractor Engine.
363. The Pruning of Citrus Trees in California.
364. Fungicidal Dusts for the Control of Bunt.
366. Turkish Tobacco Culture, Curing and Marketing.
367. Methods of Harvesting and Irrigation in Relation to Mouldy Walnuts.
368. Bacterial Decomposition of Olives during Pickling.
369. Comparison of Woods for Butter Boxes.
370. Browning of Yellow Newtown Apples.
371. The Relative Cost of Yarding Small and Large Timber.
372. The Cost of Producing Market Milk and Butterfat on 246 California Dairies.
374. A Survey of Orchard Practices in the Citrus Industry of Southern California.
375. Results of Rice Experiments at Cortena, 1923.
376. Sun-Drying and Dehydration of Walnuts.
377. The Cold Storage of Pears.
379. Walnut Culture in California.
380. Growth of Eucalyptus in California Plantations.
381. Growing and Handling Asparagus Crowns.
382. Pumping for Drainage in the San Joaquin Valley, California.
383. Monilia Blossom Blight (Brown Rot) of Apricot.
384. A Study of the Relative Values of Certain Succulent Feeds and Alfalfa Meal as Sourses of Vitamin A for Poultry.
385. Pollination of the Sweet Cherry.
386. Pruning Bearing Deciduous Fruit Trees.
387. Fig Smut.

CIRCULARS

No.

87. Alfalfa.
113. Correspondence Courses in Agriculture.
117. The Selection and Cost of a Small Pumping Plant.
127. House Fumigation.
129. The Control of Citrus Insects.
136. *Melilotus indica* as a Green-Manure Crop for California.
144. Oidium or Powdery Mildew of the Vine.
151. Feeding and Management of Hogs.
152. Some Observations on the Bulk Handling of Grain in California.
154. Irrigation Practice in Growing Small Fruit in California.

No.

155. Bovine Tuberculosis.
157. Control of the Pear Scab.
160. Lettuce Growing in California.
161. Potatoes in California.
164. Small Fruit Culture in California.
165. Fundamentals of Sugar Beet Culture under California Conditions.
166. The County Farm Bureau.
167. Feeding Stuffs of Minor Importance.
170. Fertilizing California Soils for the 1918 Crop.
173. The Construction of the Wood-Hoop Silo.
178. The Packing of Apples in California.

CIRCULARS—(*Continued*)

No.

179. Factors of Importance in Producing Milk of Low Bacterial Count.
184. A Flock of Sheep on the Farm.
190. Agriculture Clubs in California.
199. Onion Growing in California.
202. County Organizations for Rural Fire Control.
203. Peat as a Manure Substitute.
208. Summary of the Annual Reports of the Farm Advisors of California.
209. The Function of the Farm Bureau.
210. Suggestions to the Settler in California.
212. Salvaging Rain-Damaged Prunes.
214. Seed Treatment for the Prevention of Cereal Smuts.
215. Feeding Dairy Cows in California.
217. Methods for Marketing Vegetables in California.
220. Unfermented Fruit Juices.
228. Vineyard Irrigation in Arid Climates.
231. The Home Vineyard.
232. Harvesting and Handling California Cherries for Eastern Shipment.
233. Artificial Incubation.
234. Winter Injury to Young Walnut Trees during 1921–22.
235. Soil Analysis and Soil and Plant Interrelations.
236. The Common Hawks and Owls of California from the Standpoint of the Rancher.
237. Directions for the Tanning and Dress- of Furs.
238. The Apricot in California.
239. Harvesting and Handling Apricots and Plums for Eastern Shipment.
240. Harvesting and Handling Pears for Eastern Shipment.
241. Harvesting and Handling Peaches for Eastern Shipment.
243. Marmalade Juice and Jelly Juice from Citrus Fruits.
244. Central Wire Bracing for Fruit Trees.
245. Vine Pruning Systems.
247. Colonization and Rural Development.
248. Some Common Errors in Vine Pruning and Their Remedies.
249. Replacing Missing Vines.
250. Measurement of Irrigation Water on the Farm.

No.

251. Recommendations Concerning the Common Diseases and Parasites of Poultry in California.
252. Supports for Vines.
253. Vineyard Plans.
254. The Use of Artificial Light to Increase Winter Egg Production.
255. Leguminous Plants as Organic Fertilizer in California Agriculture.
256. The Control of Wild Morning Glory.
257. The Small-Seeded Horse Bean.
258. Thinning Deciduous Fruits.
259. Pear By-products.
260. A Selected List of References Relating to Irrigation in California.
261. Sewing Grain Sacks.
262. Cabbage Growing in California.
263. Tomato Production in California.
264. Preliminary Essentials to Bovine Tuberculosis Control.
265. Plant Disease and Pest Control.
266. Analyzing the Citrus Orchard by Means of Simple Tree Records.
267. The Tendency of Tractors to Rise in Front; Causes and Remedies.
268. Inexpensive Lavor-saving Poultry Appliances.
269. An Orchard Brush Burner.
270. A Farm Septic Tank.
271. Brooding Chicks Artificially.
272. California Farm Tenancy and Methods of Leasing.
273. Saving the Gophered Citrus Tree.
275. Marketable California Decorative Greens.
276. Home Canning.
277. Head, Cane, and Cordon Pruning of Vines.
278. Olive Pickling in Mediterranean Countries.
279. The Preparation and Refining of Olive Oil in Southern Europe.
281. The Results of a Survey to Determine the Cost of Producing Beef in California.
282. Prevention of Insect Attack on Stored Grain.
283. Fertilizing Citrus Trees in California.
284. The Almond in California.

The publications listed above may be had by addressing

College of Agriculture,
University of California,
Berkeley, California.

12*m* 6,'25